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ABSTRACT

Score on the Mathematics Test of the National Teacher Examinations (NTE) was the dependent variable in a stepwise multiple regression using personological variables of in-service teachers as regressors. Two variables--number of semester hours credit in mathematics, and grade level of teaching--accounted for 61 percent of the observed NTE score variance. Predicted and obtained NTE scores were compared for a trichotomous division of teachers into low, middle, and high achievement. The prediction seems adequate for use in classifying teachers by achievement in research studies without requiring costly and time-consuming testing. (Author/HM)

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Research Paper #15

PREDICTING TEACHER NTE SCORES IN MATHEMATICS

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ABSTRACT

Score on the Mathematics Test of the National Teacher Examinations (NTE) was the dependent variable in a stepwise multiple regression using personological variables of in-service teachers as regressors. Two variables--number of semester hours' credit in mathematics, and grade level of teaching--accounted for 61 percent of the observed NTE score variance. Predicted and obtained NTE scores were compared for a trichotomous division of teachers into low, middle, and high achievement. The prediction seems adequate for use in classifying teachers by achievement in research studies without requiring costly and time-consuming testing.

INTRODUCTION

The National Teacher Examinations (NTE) have been prepared and administered by the Educational Testing Service (ETS) since 1950. The NTE consists of a battery of paper-and-pencil tests designed to measure knowledge and cognitive ability in three major areas of teacher preparation: general education, professional education, and subject-field specialization. The NTE consists of a battery of Common Examinations designed to measure general teaching competencies and individual teaching area examinations. The latter were originally written and are revised each year by panels of experts selected from schools, colleges, and research programs. The tests consist of approximately 150 five-alternative multiple choise items and require two hours to administer. The revision and replacement of certain items each year permit updating of the examinations while also permitting the scaling of raw scores against previous years' tests to obtain group norms (see Buros, 1972).

NTE scores are often used as selection criteria for teacher placement. Quick, Witten, and Weinberg (1973) reviewed the extensive literature surrounding the NTE on validity and relationships with teaching variables. A potential use of NTE scores, not discussed by them or others is as a measure of teacher achievement or ability in educational research studies. Since the NTE is secure and costly to administer for many research purposes, a prediction of a teacher's NTE scores from various easily obtained teacher variables would be useful. Such scores would provide a basis for classification of teachers for ANOVA, ANCOVA, or multiple regression, commonly used in educational research. In this paper, a prediction equation for NTE Mathematics test scores is provided.

Recently, Games (1975) has questioned the use of unreliable variables for classification in factorial designs. He suggests that the effects for such factors are uninterpretable. We tend to agree in cases of nonorthogonality or for other complex situations. The basic fact of partitioning variance into explained and unexplained (error) components is unchanged, however. Where a classification variable aids in this, it will help to increase power for the other factors, even if the classification variable is ignored.

Sample

In 1971, the Minnesota Research and Evaluation Project (MREP) collected data on junior and senior high school mathematics teachers using a systematic sampling plan for schools with stratification on several demographic variables. Teachers within schools were randomly selected (see Gullickson and Welch, 1972). As part of the data collection, 127 teachers were given the NTE Mathematics Examination. A second sample was drawn in 1976. It included some teachers sampled in 1971 and a new set, which provides a sample for cross-validation.

Variables in the Analysis

Observed NTE math scores ranged from 385 to 800 (approximately the 1st to 99th percentiles from the ETS 1971 norm tables) for the 1971 sample of teachers. The mean score for the teachers was 644 with a standard deviation of 121. The NTE national norm mean and standard deviation are 639 and 83.5 for college seniors, the norm group.

Seven predictors were entered in the regression analysis. These variables are all easily measured by pencil and paper responses of teachers: (1) the number of semester hours' college-level mathematics each teacher had taken (both undergraduate and graduate); (2) number of advanced mathematics courses taught (algebra, geometry, and analytics, etc.); (3) student grade level of teaching; (4) number of years since the teaching degree was obtained; (5) number of semester hours' work in mathematics since the last degree obtained; (6) number of years teaching experience; and (7) number of semester hours' coursework in science.

The regression analysis used was a forward stepwise multiple regression. The predictor correlating highest with NTE score is entered first. The residuals of this regression are correlated with the remaining predictors and the most highly correlated of these is selected. A new regression equation is constructed with the two predictors, and so on. At each entry all regression variables are tested as if they were the last included (F-test for inclusion). The overall variance of the regression equation (overall regression F-test) is also examined. The regression program used was from the Statistical Package for the Social Sciences (1974), using pairwise deletion for missing data, which comprised less than 12% for six of the seven independent variables.

Results

Using the criterion Draper and Smith (1966) suggest that the overall regression F-value be four times the critical value, and our own criteria that the variables be meaningful and significant at $p \leq .01$, two variables were found to predict NTE mathematics scores. Variables (1), total semester

hours' work in mathematics, and (3), grade level of teaching, accounted for 61 percent of the variance (R^2 = .611) of NTE scores. The wording of these questions, the regression table, and the final equation are given in Table 1.

Table 1: Variable List and Regression Table for NTE Mathematics Prediction Study

Variable List

Variable 1: "Please indicate the number of undergraduate and graduate hours you have taken in mathematics." (Multiply quarter hours by 2/3 to get semester hours.)

Mathematics_____

Variable 3: Grade level of students in the majority of the classes you teach. (Paraphrased from the original set of questions.)

Regression Table

Variable	F to Enter	Probability	Total R^2	b-weight	Overall F	Prob
1	55.6 df = 1.47	<.01	.54	3.497	55.6 df = 1,119	<.01
3	8.2 df = 2.46	<.01	.61	23.99	36.1 df = 2.46	<.01
Constant	---	--	--	413.09	---	--

Prediction and Cross-Validation

The prediction equation recommended for use by researchers is

NTE = 3.497 x (# credit hours math) +
23.99 x (grade level of classes) +
413.09

The utility of a simple prediction equation for NTE Mathematics scores lies in quick classification of teachers into ability groups for research purposes. Either covariation or use in a factorial design may be quickly accomplished without recourse to costly and time-consuming testing. Of course, the predictions are limited and are not entirely suitable for more exacting requirements.

To examine the classificatory function of the regression equation, teachers in the 1976 sample were grouped into top, middle, and low 33rd centiles from the 1971 sample's observed NTE scores. Predicted NTE scores using the 1971 equation were computed for teachers with complete data on variables (1) and (3), a total of 66 scores. The contingency table for predicted vs. actual achievement grouping was constructed and is given in Table 2. Note that misclassification is small between high and low achievement groups. Porter (1967) and Glass, Peckham, and Sanders (1972) discuss the problem of fallible covariates, if one is to use the predictions as a covariate. The correlation of predicted and observed scores is .67, while for the trinomial contingency table the contingency coefficient is .65, which is equal to $\sqrt{x^2/(x^2+N)}$, where x^2 is the familiar chi-square statistic of association. Kendall's tan for the 3x3 table is .59; these coefficients indicate that the

prediction is accurate in gross trinomial classification about 2/3 of the time. Extreme misclassification (from actual Low to predicted High, and vice versa) occurred for only one case out of 66 in the cross-validation.

Table 2: Cross-Validation Contingency Table of Actual and Predicted Achievement Grouping for NTE Mathematics Scores of 66 Teachers

Low Achievement (Score less than 600)

Middle Achievement (Score between 600 and 675)

High Achievement (Score above 675)

		Predicted Grouping			
		Low	Middle	High	
Actual Grouping	Low	11	0	0	11
	Middle	3	6	6	15
	High	1	12	27	40
		15	18	33	66

A similar regression was performed for science teachers' NTE scores and a disappointing negligible percent of the variance was predicted. This suggests that the differences in training, ability, and knowledge of junior and senior high teachers are more pronounced in secondary math teaching than in science.

Conclusion

The prediction equation presented in the paper may be used by researchers as a means to predict teacher mathematics achievement on the NTE. Suggested use is for blocking or covarying to gain power in research studies.

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